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# Problem-Solving in Solid Waste Management Through Federal-Local Cooperation: 8 Case Studies

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# problem-solving in solid waste management through federal-local cooperation

## 8 case studies

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# problem-solving in solid waste management through federal-local cooperation

## 8 case studies

This digest (SW-134)
summarizes the experiences of eight communities
receiving major technical assistance in solid waste collection
under a special Federal environmental protection program.

The publication was compiled by
BRUCE WEDDELL and MARTHA MADISON

U.S. ENVIRONMENTAL PROTECTION AGENCY
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in the solid waste management series

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## FOREWORD

During the past three years, the U.S. Environmental Protection Agency's solid waste management program has conducted a major technical assistance (MTA) program to meet the growing need for new approaches to solving solid waste management problems. The objective of the technical assistance program was to develop and field test a set of real-world tools and techniques in response to community situations.

Although both collection and disposal problems were addressed, the major thrust was in the area of increasing collection productivity. We selected this area first because collection accounts for as much as 75 percent of many local solid waste budgets. Savings that could be achieved in this area could then be applied to offsetting the increasing cost of environmentally acceptable disposal.

The MTA program assisted several communities to greatly improve their solid waste management systems while simultaneously it developed a number of problem-solving tools and techniques. As can be seen from the following digest of summary reports, the tools were designed for easy application by local communities, and provide a step-by-step procedure for improving local collection productivity.

These tools and techniques, used in most of the cities in the MTA program, have enabled communities to either reduce costs dramatically, or to increase the quality and reliability of their collection systems while holding the line on previously soaring collection costs.

A brief description of these tools and a collection of summary reports are presented in this publication. Two of the reports illustrate the benefits of regional disposal, while the remaining six address the issues surrounding collection productivity. All eight summaries illustrate what can be achieved when forward-looking public officials and management personnel expend the time and energy necessary to overcome the reluctance to change that exists in many communities today. We hope that these examples will encourage additional cities to take the steps necessary to achieve similar results.

—ARSEN J. DARNAY
*Deputy Assistant Administrator*
*for Solid Waste Management*

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East Peoria, Illinois, 12

- Through the purchase of new equipment and better routing, efficiency was increased resulting in reductions in manpower and overtime pay. Openbed trucks which had been used during equipment breakdowns are now used less often.

Hot Springs, Arkansas, 16

- A change from unregulated private haulers to a city-controlled franchise system has increased efficiency and reliability of service.

Little Rock, Arkansas, 20

- New equipment was purchased and crew size was reduced from 5 to 4 men. The overall savings has been applied toward offsetting the increased haul costs and operating costs at the city's new disposal site.

Portland, Maine, 23

- Frequency of dry trash collection was increased from biweekly to weekly and the number of dwellings eligible for city service was increased 10 percent while the total collection budget has been reduced.

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# TOOLS AND TECHNIQUES

# FOR IMPROVING

# SOLID WASTE COLLECTION

The Office of Solid Waste Management Programs (OSWMP) has devised a number of tools and techniques which are helpful in improving productivity and reducing the cost of solid waste collection. These tools have been designed for ease of application, and can be used by solid waste managers and consultants.

They are described below and are essentially modern management methods as applied to residential solid waste collection systems. The regional reports contained in the main body of this digest describe some of the successful applications of these methods. Reports describing these methods in greater detail are listed in Appendix B, along with information on how to obtain single copies free of charge as supplies permit.

## FIVE-STAGE IMPROVEMENT PROCESS

This process is a logical common sense process which enables a critical evaluation and redesign of collection systems. It guides the user from the initial policy decision and design phases through actual implementation. The five stages are:

1. *Review of Existing Policies and Methodologies and Their Alternatives*–There are two policy levels:

   *System Policies*
   - Organizational policies
   - Level-of-service policies

   *Operational Policies*
   - Route policies
   - Labor policies
   - Management policies

2. *Macro-Routing*–Determination of optimum assignment of the daily collection routes to existing or proposed processing and disposal facilities.
3. *Districting and Route Balancing*–Determination of a "fair day's work" and the structuring of collection areas so that all crews have equal workloads.
4. *Micro-Routing*–Determination of the actual route the individual collection vehicles will follow in collecting waste from each service in a specified area. Heuristic Routing,

the method of micro-routing we have found most effective, utilizes human talent, common sense, and knowledge of the local area rather than depending on sophisticated computerized methods.

5. *Implementation of Changes*

## COLMIS–A COMPUTER PROGRAM

Computers are still thought by many people to have application only within scientific laboratories or in government operations such as the Internal Revenue Service where large amounts of data must be correlated and analyzed. But, in the last decade, computers have become involved in everything from the guidance of space vehicles to the design of automobile tires. Computers have also become an important tool in the management of retail sales, food processing control, and agricultural operations, to give a few examples among many. Computers can be useful in the management of almost any large-scale enterprise.

OSWMP has available a computer program for the management of residential solid waste collection activities. The program is called COLMIS, which stands for **COL**lection **M**anagement **I**nformation **S**ystem.

COLMIS produces definitive information on the operational aspects and costs of collection, and was designed to accomplish two objectives: to provide managers at all levels with a tool to facilitate the decisionmaking process, and to provide the necessary information for detailed evaluation of the needs for and effects of change in operational procedures.

Providing information at every level in the organization enables each manager to evaluate his performance by his own standards and in comparison to the performance of other managers. In examining his operation he is able to review the activities of all his subordinates and pinpoint the need for improvements. The reports produced by COLMIS also serve as a creditable record of operations and costs.

As a planning tool, the COLMIS reports provide the specific data needed to gauge truck and crew requirements for an entire collection area and a fair day's work for each crew. The reports can also be used to establish boundaries for daily routes and collection districts. As an on-going part of a collection system, the reports can aid in determining the useful life of equipment and thus help in planning a capital replacement program. The COLMIS reports can also be useful in the analysis of crew size and management structure and in the determination of the types of equipment to be used.

### Input Requirements

There are two kinds of input data required for the operation of COLMIS. One is background or general information which is placed in the computer program. It is collected at the time the system is implemented. Included are items such as vehicle costs and useful life, salaries and fringe benefits. This type of data is relatively stable and is re-entered into the system only if the values used are changed.

The other type of input is daily operational information. Each day, each driver of a collection vehicle completes a simple form which outlines his crew's activities for the

day. The form was designed to make this job as easy as possible and to take the driver only a few minutes to complete. It is necessary, however, that the drivers be able to read, write and tell time. The data provided, including times and mileage when specific actions were begun and ended, make it possible to set forth in report form an accurate accounting of how the collection operation functions on a day-by-day basis. Daily activities to be monitored encompass traveling from the motor pool to the route, collecting solid waste from the residences, transporting the waste to a disposal point, and returning to the motor pool.

Data Processing

The COLMIS program, which converts the input data to management reports, is of relatively simple design. It is written in Fortran IV computer language and will operate on computers generally available throughout the nation. Weekly computer operating time for a city having 30 routes would probably be between 20 and 45 minutes, but would depend on the capabilities of the computer used.

Management Reports

COLMIS reports are generated on a weekly and monthly basis. Weekly reports are geared toward direction and control of the collection operation. There are four parts to each set of weekly reports: route information dealing with times, miles and weights; collection information dealing with characteristics of the area collected and parameters of crew performance; collection cost information showing a breakdown of the cost of collection activities; and a collection system operation summary providing a capsulized picture of the most significant items from the other three sections. One set of weekly reports shows the day-by-day performance of each crew and is aimed toward the immediate supervisor of the collection crews. Reports for middle management give only a summarization of weekly activities for each crew. Top management's reports contain summary information on the total operation with a breakdown by organizational units (i.e., assistant superintendents, supervisors, foremen), if applicable. In addition to these, management analysis reports comparatively rate the performance of the crews or organizational units on 10 performance indicators such as weight collected and homes served. These are most useful to route foremen and middle management.

Monthly reports are prepared in a four-part format identical to the weekly reports; however, information is summarized by day of the week for each crew. This makes it possible to compare the operation on Monday to that on Tuesday, and makes comparison of all crews on each day of the week feasible. These reports can be very helpful in evaluating the balance of work loads throughout the week. Middle management receives a summarization of the whole month for each crew. And top management is provided with an overall summarization with optional breakdown by organizational unit. Management analysis reports are also generated. Monthly reports serve a dual purpose. They complement the weekly reports when used as an operational management tool, and they provide a well organized data base for planning collection system modifications and improvements.

It is the purpose of COLMIS to provide a systematic base of information from which all levels of management can plan and operate an effective and efficient solid waste collection system.

## DISTRICTING AND ROUTE BALANCING

Districting and Route Balancing is a method of determining a fair day's work and of dividing the collection areas into balanced routes wherein all crews have equal workloads.

The objectives of a fair day's work determination and Route Balancing may be:

1. to estimate the number of trucks and men required to collect the waste in order to determine a reasonable bid price for a collection contract or to design a new system.
2. to evaluate the performance of the collection crews, both individually and collectively
3. to establish a standard to be used in a task system (whereby the crews may go home when their predetermined tasks are completed for the day) or in a wage incentive system (whereby the crew is rewarded in financial bonuses for any increases in productivity over a standard or over previous performances)
4. to balance or equalize the workloads among collection crews.

Districting and Route Balancing is required if any of three situations occurs:

1. *If a collection contract is up for bid*—In order to obtain insight into what constitutes a reasonable bid price, and to eliminate much of the guesswork in bidding, it is in the best interest of the customers for both parties of the contract process to have the basic information required to determine a fair bid price.
2. *If a major change occurs in the system*—A major change occurs when there are changes in policies and methodologies (such as backyard to curbside collection or public to private contractor system) or development of new disposal facilities or assignments to facilities.
3. *If the crew performances have never been evaluated or need re-evaluation*—Current routes may be unbalanced if Route Balancing has never been performed or if new accounts have been added (e.g., construction of new homes) or other accounts deleted (e.g., urban renewal). Inadequate standards or assigned tasks mean routes may be too large, requiring excessive overtime, or too small, requiring too much incentive time (time paid for but not worked).

Districting and Route Balancing is accomplished by analyzing the time components for the work day; that is, travel from garage to route, collection route, haul to disposal site, and return to garage, as well as lunch and other breaks and allowances for time lost due to breakdowns and other delays. Also taken into account in defining a fair day's work are distances from street to storage, housing density along the collection route, and amount of waste to be collected.

## MACRO-ROUTING

Macro-Routing is a procedure for determining the most efficient assignment of collection routes to disposal facilities. When only one or two disposal facilities need to be considered, the solution is readily apparent: minimize the round-trip haul time for each route, taking into account the queue times at each site.

When many different facilities are to be considered, such as shredders, balers, incinerators, transfer stations, compost plants and landfills, the following factors must be considered in optimizing the system:

1. *Fixed and operating costs of each facility*—As an example of the way in which this factor can affect the total cost of a system, consider the economics of operating an incinerator. Because of the high capital investment involved, the daily fixed cost (bond principal, interest, insurance, etc.) is also high. Added to the fixed cost is the actual cost of operating the facility (labor, fuel, electricity) at a certain level. If that level is increased, the total cost increases also, but only by the additional operating expense, since the fixed cost has already been "paid" by starting the facility at all. This marginal increase is relatively small, and might be less expensive than sending a collection vehicle to a closer site.
2. *Short and long range capacities of each facility*—If an incinerator has a daily capacity which is not being used, it may be desirable to run it at maximum in order to extend the life of a landfill.
3. *Round-trip haul time (cost) for each route, accounting for queues at each facility*—This is the total transport and discharge cost incurred each time the crew goes to a disposal facility.
4. *Effect of facility on collection equipment*—Many disposal sites have poor access roads and discharge areas which cause flat tires, stuck vehicles, wear on transmissions and differentials, as well as lost time; most processing facilities have concrete pads at the discharge areas, making them much easier on equipment.

## HEURISTIC OR MICRO-ROUTING

Heuristic or Micro-Routing is a simple, noncomputerized, commonsense approach to minimizing the noncollection distance and delay times for each collection vehicle. The heuristic approach is based on several rules of thumb; for example, routes should be compact, continuous, and contiguous; they should be initiated as close to the garage as possible; they should avoid heavily traveled streets at rush hour; they should follow determined patterns when collection is made on one side of the street or on both sides. Because of its simplicity, Heuristic Routing has the added advantage of rapid application by local officials.

## AKRON, OHIO[1]

The City of Akron's residential solid waste collection system was antiquated and inefficient. It consisted of garbage-only (i.e., food waste) collection by the city and dated back to the early 1900's when the City started collecting the garbage for health and sanitation reasons. The residents had to either contract with a private hauler to collect the rest of their waste or haul it themselves to the City disposal site. The City collected the garbage from residential backyards at a frequency of once every seven working, or nine calendar days. The problems with this system were:

1. Frequency of collection—every nine days, unless it rained, which made it longer—was unacceptable.
2. Routing methods were inefficient; for example, at the end of each collection day, the collectors would color in a route map to show which streets had been collected.
3. Cost to the citizens was high because the City's collection fleet was underutilized (20-cubic-yard packers were collecting considerably less than one load of garbage each day), and superfluous collection resources (labor and equipment) were required for private haulers to make additional passes to pick up the remainder of the waste.
4. With the public sector collecting some waste and the private sector collecting the remainder, it was difficult to control which wastes were to be picked up by the public (for "free") or by the private (at a fee). Without an end use for the separated wastes, and since all wastes went to the same landfill anyway, there was no incentive for the City to encourage or for the citizens to comply with the idea of "clearly" separated wastes.
5. Experimentation in parts of the city showed that citizens preferred curbside, once-a-week collection of combined wastes.

The City decided to improve its residential solid waste collection service. The City Administration with the backing of the City Council took a careful step-by-step planning and implementation course in this upgrading effort. In 1969, the Department of Public Service experimented with curbside, twice-a-week collection of combined refuse in free plastic sacks in an area containing about 1500 dwellings. In 1970, this area was expanded to about 5000 dwellings by including the Model Cities neighborhood with the same collection service except that the frequency was changed to once a week.

In January 1972, the city implemented a curbside, once-a-week, combined waste collection experiment in the North Hill area containing about 5000 dwellings. Here, however, participation was on a voluntary basis (residents could continue to contract a private hauler), only one- and two-family units could participate, and the residents were given the choice

[1] Appendix A lists names and addresses of local and Federal personnel involved in this project.

of providing their own plastic sacks or using 20-gallon cans. Within two months, an adjacent 5000-dwelling area was added to this program. The major concern of the City Administration was how the citizens would react to such a new system of combined wastes. Curbside, once-a-week collection was selected because it was of sufficient frequency and was less costly than the backyard or twice-a-week collection alternatives.

Besides citizen acceptance considerations, the City was concerned with how the new system would be financed and how much it would cost relative to the existing budget. The City was also considering supplying the citizens with plastic sacks.

This was the status of the progress of the City of Akron toward a new system when EPA offered technical assistance, and the City accepted the offer in November of 1972.

## HOW EPA AND CITY PERSONNEL IMPROVED THE COLLECTION SYSTEM

From December 1972 to February 1973, data were gathered on the existing experimental areas, and during March and April a suitable collection system was designed. From May to July the City Council made its necessary approvals, bids were made and a contract was given a private hauler, final routing decisions were made and citizens were notified of the new system. On August 6, 1973, the new system went into effect.

The Project Officer, from the EPA's Office of Solid Waste Management Programs (OSWMP), had been in Kansas City, Missouri, to observe its transition on March 1, 1971, from a system very similar to that in Akron (separate garbage collection by the City) to once-a-week, plastic sack, combined collection and was able to draw upon this experience of a very smooth transition in advising the City of Akron.

OSWMP installed the COLMIS computer program, and the information gathered in the North Hill test area (three routes) and in the Model Cities area (two routes), both once-a-week, combined, curb service, provided the basic information used by the City and OSWMP in designing the new City-wide system.

A number of major decisions were made after OSWMP became involved. For example, as to whether the implementation should be gradual—converting one or several routes at a time to see how many resources are utilized and to minimize the area of concentration—or one-shot City-wide, the City decided to divert from its conservative course and to do a City-wide implementation. Project personnel felt a good estimate of resources (trucks and men) and costs could be made based on the existing North Hill and Model Cities data and data from other cities, including Kansas City, Missouri. They also felt implementation would be facilitated by City-wide conversion and that all of the citizens of Akron should receive the improved service at the same time and as soon as possible.

As to whether the City should provide plastic sacks, OSWMP supplied the City with cost and usage estimates in order to make this decision. The City finally decided not to provide sacks since the sacks meant a rather large capital outlay, procurement and distribution of the sacks would be a continuing problem and would compound implementation tasks and costs, and a large usage could probably be obtained on a voluntary basis anyway.

In order to minimize labor problems during transition and requirements for more and different trucks, the City decided to keep the same three-man crew size. After implementation of the new system, the City could evaluate the use of one- and two-man crew sizes based on information which OSWMP supplied the City and on the characteristics of the new operation.

Based primarily on the budget constraints and the fact that the private sector already serviced larger units, the City decided to provide its collection service to one- and two-family units only. The City also decided the new system would be on a voluntary basis because of State requirements for citizen approvals for billing purposes and because of concern for citizen and private hauler reactions. OSWMP felt the system should be mandatory in order to facilitate route design and route balancing, and to avoid:

1. the high cost of initially identifying who wanted the service and who did not
2. the operational costs and problems of learning who does and who does not receive City service and of adding and deleting specific customers
3. duplication of effort by the public and the private sectors.

COLMIS was installed on the three North Hill and two Model Cities routes and four weeks of productivity data (number and types of containers per residence, number of residences per day, pounds of waste per day) and time data (garage to route, route to disposal site, disposal site to garage, lunch and breaks) were collected and processed. From these data, a report was prepared showing the resource and cost calculations and results. Using conservative estimates, the results showed 22 to 24 routes would accomplish the job with minimum overtime costs. The total estimated annual cost for 24 routes was $1.37 million, or $1.56 per home per month. These figures assumed 100-percent participation of the one- and two-family homes. The existing solid waste operating budget was $830,054 for food-waste-only collection. Adding an annual equipment expense of $75,000 (five-year straight-line depreciation for the 21 packer trucks) yields $905,054. Private sector collection fees were typically $3.50 to $4.00 per home per month, making the total cost of the existing collection system to the citizens of Akron $3.48 to $4.36 million per year.

Estimates of seasonal waste loads showed Akron to be similar to the typical northern city pattern with a low from January through March, rising to a peak in late April and May, running high and constant over the summer, declining slightly toward the end of August and October, then rising to another peak in the leaf season during November. With three-man crews and seasonal peaks lasting only four weeks a year, it was decided to operate with overtime during the peaks, at a normal 7 to 8 hours during most of the year, and less during the winter low (on a task system basis whereby the crews go home when their routes are completed.).

Should the new system be public or private or a combination? OSWMP personnel discussed the pros and cons of each of these arrangements with the City personnel who either favored public or a combination. OSWMP recommended a combination, as Kansas City, Missouri, had done, with the following reasoning. With the shift in collection from backyard to curbside, from separate to combined waste collection, and the limiting to only one collection agency per street segment, the total equipment and manpower resources (public and private) required for the collection of residential waste would be sharply reduced. Also, the City wanted to maximize the use of its existing equipment and manpower resources. The result of this policy decision was to transfer the burden of excess equipment and personnel to the private sector, although under the proposed system, the City would no longer collect from apartments.

To help soften the burden of cutback on the private sector, to permit the City to compare the performance of the public to the private collection crews, and to build into the system an inherent competitiveness between the public and the private sectors, OSWMP recommended contracting out part of the City rather than expanding the City resources. It was further argued that, since the City would use its existing resources, three alternatives existed for obtaining the additional vehicles required: outright purchase, leasing, or utilization of private contractors. Outright purchase would enable the City to operate all collection crews in the new system. Such purchase, however, would involve a large capital outlay and a long lead time, generally at least six months. Leasing would also suffer from the same difficulty of lead time and is in addition thought by many officials to be less cost effective than outright purchase. The advantage of leasing, of course, would be less initial capital outlay. Aside from immediate costs, however, the purchase or leasing options suffered the disadvantage of not utilizing the resources immediately available in the private sector. Therefore, the City decided to use 17 City routes (keeping four trucks as spares) and contract out the remaining four to six routes. The City was supplied with sample contracts to assist in developing its contracts. The City received two bids by the specified deadline hour and returned others unopened which were received after the deadline. One bid was for one route only and was higher than the other so the one bidder who bid on the whole area received the contract. The rate of $2.21 per month per home was considered very reasonable.

The City employed the techniques of route balancing and heuristic routing. The heuristic routing procedure was explained to the crews who knew their route areas and, therefore, could effectively develop their own routings. The City assisted on some of the routings and found the crew-developed routes to be very efficient.

In order to help implement the new system, the City gathered examples from other cities of brochures, newspaper articles and letters to the citizens from the mayor explaining the new system, its implementation date, and what was expected of the citizens. Akron effectively developed its own public information system from these examples.

The City decided to bill participating customers for the difference in cost between the existing budget and the new cost. For implementation and for determining what to charge, the City conducted a random survey of citizens to determine what the participation rate would be. Based on

this and an estimated quarterly billing cost of 15¢ per home for each billing, a $1 per month user charge was determined to be the user fee. The charge was to be effective January 1, 1974.

COLMIS was installed on the City's computer system with the intention that the program would be used after implementation of the new system in order to "fine tune" the route balancing and to compare crews, both public and private.

## RESULTS

On August 6, 1973, the new City-wide curbservice collection system was put into effect without problems. Now all one- and two-family detached residential units may receive weekly curbside collection of combined wastes on a voluntary basis from the City for $1 per month. The new system has the following additional advantages:

1. The citizens of Akron save between $1.5 and $2.0 million per year.
2. The number of complaints has decreased from an average of 56 per day before implementation to about five per day after.
3. The combined waste and reduction in packer trucks operating in the City and at the disposal site has enhanced the landfill operation.

As of January 16, 1974, 71.5 percent of the one- and two-family units in the City responded to the 100-percent mail survey to accept the City-provided service at $3 per quarter; 12.7 percent declined the service and 15.8 percent did not respond at all. A special billing section was set up in the Public Utilities Bureau to handle the billing and collection of the service fee.

Neither the City nor the private hauler has experienced any major operational problems. However, to avoid the problem of determining which homes are or are not participating customers, the City operational unit decided to pick up all the waste placed at the curb. When the City finalized the list of participants, the operational force anticipated it would continue this policy, but a policing force would probably be used to identify non-participants who put their waste out to be collected.

The original resolution passed by the City Council in going to a public/private split on the new system provided for the preparation of a report comparing the performance between the systems. The City reports that data from the second through the fourth months (see the table below) showed the public sector outperforming the private sector on a tonnage per hour basis by a factor of almost two to one. (The private collector picks up more tonnage per day but at a slower rate.) City crews are allowed to take 30 minutes for lunch, 30 minutes for breaks, and 15 minutes for cleanup. In nearly all cases, the City crews choose to work until their route is completed and not take the allowable time. If allowable time is included, City crews still average 20 percent more tons per hour than the private haulers. This, the City feels, demonstrates the benefits of incentive time under a task system.

| Month | Sector | Average Hrs/day/crew | Average Tons/day/crew | Average Tons/hr |
|---|---|---|---|---|
| Sept 73 | Public | 5.40 | 10.5 | 1.94 |
| | Private | 10.78 | 10.1 | 0.94 |
| Oct 73 | Public | 5.63 | 10.8 | 1.92 |
| | Private | 9.58 | 11.6 | 1.21 |
| Nov 73 | Public | 6.10 | 12.1 | 1.98 |
| | Private | 10.03 | 14.4 | 1.44 |
| Average | Public | 5.71 | 11.13 | 1.95 |
| | Private | 10.13 | 12.03 | 1.19 |

Other factors must be considered in evaluating the difference in performance between public and private crews: the City has 17 crews who service an average of 490 homes each day, whereas the private hauler has four crews with an average of 512 homes per crew per day. Housing density is less in the private area than in the area served by the City. On the other hand, traffic congestion is higher in many of the City-collected areas, and the private-collected areas are closer to the disposal site than most of the City-collected areas.

## FINANCIAL BENEFITS

In the old system the homeowners were paying $3.50 to $4.00 per month to private haulers, and an average of 93¢ per month through taxes for the municipal garbage-only service. This totaled $53.16 to $59.16 per home per year for collection. The new system is estimated to cost $1.93 per home per month, or $23.16 per year. Of the 95,000 families in Akron, 72,000 qualify for City curbservice; 72 percent, or 52,000 have signed up. These residents save between $1.56 and $1.87 million per year.

## EAST PEORIA, ILLINOIS[1]

East Peoria is a suburb of Peoria, Illinois, lying southeast of Peoria and on the opposite side of the Illinois River. It has a population of 20,000 persons living in 6100 residences. The 80 commercial establishments add the equivalent waste of 100 residences.

Prior to EPA's Major Technical Assistance in July of 1972, East Peoria's solid waste system was both expensive and undependable. Collections were irregular, and practically no records were kept of daily collection activities. The system, if it could have been called such, was plagued by frequent breakdowns resulting in many overtime collection hours; exhorbitant maintenance costs compounded this expense. Service to commercial establishments was provided at a disproportionate rate relative to residences, and in most instances the establishments were paying less than the actual effective cost of service. Also, the extra crews and dump trucks used for bulky waste collection were, at best, used inefficiently.

A large part of the problem was the result of management neglect. Management was essentially split between the Commissioner of Public Health and Safety (one of the four Councilmen for the City) and the Director of Public Works.

The Commissioner's job is part time, since he holds a full-time job on the outside as his main source of income. In addition, the management of the solid waste system is only a portion of the responsibility of the position of Commissioner of Public Health and Safety. Consequently, very little time could actually have been spent on the management of the collection system.

The Public Works Director, on the other hand, was really involved in no more than the hiring, pay and personnel activities of the collection system. The day-to-day supervision of the collection operation was left up to the senior driver of the collection vehicles. He acted basically as a foreman, but he did not have the expertise or background necessary for the efficient operation and maintenance of the collection system.

### HOW THE SYSTEM WAS IMPROVED

The Office of Solid Waste Management Programs became aware of the situation in East Peoria via a pre-application proposal submitted by the Tri-County Planning Commission in answer to OSWMP's solicitation for the demonstration of improved local and regional solid waste management systems. East Peoria had approached the Tri-County Planning Commission to secure aid in designing a better collection system.

Prior to OSWMP involvement, the City had initiated plans to purchase two one-man side

[1] Appendix A lists names and addresses of local and Federal personnel involved in this project.

loading compactors for collection of household waste. A preliminary analysis indicated that this equipment and crew would be adequate to handle the City's collection requirements although a recommendation was made for providing a back-up vehicle.

East Peoria's main objective was to design a new, efficient and cost-effective collection system. To achieve this end, the City asked OSWMP to analyze the management system, to make recommendations, and to review the existing solid waste ordinances and show where improvements could be made. On July 15, 1972, Major Technical Assistance activities were officially begun.

A detailed map of East Peoria showing the number of dwelling units per block face was prepared, and a survey of commercial establishments was carried out to find out the number and location of establishments served, the volume of waste per establishment per week, and the type, size and number of containers used by each. The map and the information on commercial establishments was eventually used in setting up collection districts and in designing specific collection routes.

A sample survey of commercial establishments and single- and multi-dwelling residences was made to determine the amount of property tax paid by each and to determine the portion of that tax which paid for collection services. Using the sanitation tax levy of $.0757 per $100 valuation, the average tax payment per year to the Sanitation Department was found to be $5.83 ($.112 per week). The average generation rate of 60 pounds--or two 20-gallon containers--per household per week, a value projected by the Tri-County Regional Plan Data of 1972, became the allowable standard for the commercial customers served. It was planned that in instances where commercial customers pay less sanitation tax than $.112 per 60 pounds or 40 gallons per week, the difference would be levied as a user charge in a proportional or straight line manner.

Using the dwelling unit data and other design parameters specified by the City, a collection system was designed. Since the City did not accept the recommendation to acquire a back-up vehicle, the system was designed to minimize the effect of vehicle breakdown. The three vehicles finally decided upon by the City were two 29-cubic-yard one-man side loaders and a two-man 25-cubic-yard rear loader.

The collection system design was simple and straightforward. The City was divided into five districts of approximately equal number of dwelling units, with adjustments for density variations. Only one district is collected on a given day. Each district is divided into three routes labelled A, B, and C. Each week crews and trucks rotate; one truck collects all A's one week, B's the next, and so on. The two-man rear loading vehicle collects both household and bulky wastes. On holiday weeks, collection days are slipped for the remainder of the week and Saturday is catch-up day.

For special situations, one of the previously used dump trucks and a two-man crew are kept on a call-as-needed basis for unscheduled pickup of bulky items. (In the old system, bulky waste collection required six men and three trucks on a part-time basis from the Street

Department.) This service is paid, at least in part, by user charges. Since this crew is also familiar with the regular routes and equipment operation, it can stand in for sick leave or vacations of the regular crew.

To minimize the effects of having no back-up equipment, the following procedure was used. If one of the one-man trucks is out of commission, the crew member helps the other one-man truck complete both routes, working overtime if necessary. The rear loader may also be used to help. If the rear loader is out of commission, the two-man crew is split between the side loaders and the extra route is divided in half.

Under normal operation, the crew for the two-man rear loader alternate by the hour or half-day between driving and collecting. The driver only helps on bulky waste or unusually large amounts of waste at a given stop.

In addition to the above-described collection system, it was recommended that a supervisor familiar with solid waste management practices be assigned full-time to be responsible for maintaining the system in efficient operation and making adjustments and changes as required to meet changing situations. The recommendation was rejected, however, since the City felt it could not afford the added expense. Indications are that such a position may be established some time in the future.

The survey of property taxes and amounts of these taxes paid for the collection of solid waste revealed that many commercial accounts appear, in effect, to be subsidized by the residents. However, under closer examination, the total system was found to be subsidized by taxes paid by a few very large manufacturers whose waste was not being collected by the City.

Recommendations were made to the City to drop the existing 80 commercial customers as a way of saving money or, as a second choice, expanding the service to include all the commercial accounts paid by a user charge system. The latter choice would have required additional equipment and manpower and was not pursued in detail because of the City's desire not to move in this direction. Instead the City adopted a middle-of-the-road system that would maintain the existing commercial accounts, eliminate higher frequency service and drop any customers requiring bulk containers.

The bid specifications were prepared by City/Tri-County personnel, approved by council, and issued in early October of 1972. Purchase orders were placed during mid-October with a promised delivery date of mid-January. It was estimated that implementation of the new system would take place in late January 1973. The two-week period between delivery and implementation would be to train operators. However, the delivery schedule slipped to mid-June because of a strike at one of the part manufacturer's plants.

With the arrival of the equipment, revised ordinances were approved by council, and the information system designed to inform the public about the new collection system was started.

## RESULTS

The new system has provided a more regular and dependable collection service through improved routing and utilization of equipment. However, savings and system improvements would have greater continued assurance if a full-time manager knowledgeable in solid waste management was hired. In addition, the lack of proper back-up equipment may also prove to be more costly than the purchase of such equipment.

## FINANCIAL BENEFITS

The projected savings on the new system were expected to be on the order of $100,000 annually, but have turned out to be considerably less due to breakdown costs, manpower overtime costs, and the lack of full-time managerial direction. However, the savings that were realized have been used for the payments on the new equipment, and to offset the cost of a new municipal building which has garage facilities, a maintenance department, and a parts inventory department.

## HOT SPRINGS, ARKANSAS[1]

When the Major Technical Assistance effort began in March 1972 there were approximately 17 private haulers operating in this city of 35,000 persons. Because the haulers were not regulated in any manner, they were allowed to do business throughout the entire City. As a result, it was not uncommon to find several haulers on the same block at different times during the same day.

The equipment used by the haulers varied from a relatively new rear loading compaction vehicle to open pick-up trucks. If a collection vehicle was out of commission on a given day, it was rare if a back-up vehicle was available. The overall poor condition of the collection vehicles and the lack of back-up equipment resulted in very unreliable service. Even though residents paid for twice-per-week service, the best service given was weekly. Residents reported service as infrequent as once per month or even once every six weeks. Both residential and commercial accounts reported similar poor service, but the commercial accounts received better service because of the larger amounts of money involved.

When the study started, the basic charge for residential service (backyard service twice per week) was $3.00 per month. After the City announced plans to take over the collection service, the charge was increased steadily until fees as high as $8.00 per month were reported just before the City initiated collection operations. It is not known for certain, but a similar situation probably existed for commercial establishments.

At approximately the same time that the project began, the State closed the largest land disposal facility in the area; it had been a classic town dump. To replace this facility a landfill was opened on a State-approved site approximately 12 miles from the center of Hot Springs. But lack of operator competence and/or proper guidance has caused this site to become another dump. The City plans to use this site for only a short while. The refuse from a large part of the County will continue to be placed in the fill after the City leaves.

The City had initiated the change in the local solid waste management system and had passed a bond issue in excess of $1 million to finance a collection and disposal system for the City. The heart of the proposed disposal system is a 100-ton-per-day incineration facility. With the incinerator now open, the City uses a fill site within the city limits for the residue disposal.

The City had also planned a fairly unusual method to use the present haulers in the residential collection system. Contracts between the private haulers and the City were being prepared. Basically the haulers provide the necessary labor and the City provides trucks, all operating and maintenance equipment, and disposal facilities. The City hired its own drivers to provide service for the bulk containers.

[1] Appendix A lists the names and addresses of local and Federal personnel involved in this project.

## IMPROVEMENTS MADE IN THE LIMITED TIME AVAILABLE

When the original agreement was made to provide technical assistance, the severe time constaints restricted the project scope to little more than vehicle routing and route balancing. It seemed inappropriate to recommend specific vehicle types, especially since the City's plans at that time were to initiate collection service on September 1, 1972. There was a 90-day lead time required to order collection equipment, and there would not have been enough time to study the City and determine the truck type best suited to the City's needs, and besides, the City seemed to have a firm idea of the trucks they were going to purchase anyway. The situation was comparable to other MTA cities where a new system is designed around the vehicles already in use.

Since the City had already committed itself to purchasing a specific type of incinerator, it was neither timely nor appropriate to conduct a formal effort for the processing and disposal aspects of the system.

In addition to the bond issue, the City Council passed an ordinance establishing a Sanitation Department and the regulations which would govern the solid waste management system. OSWMP helped design the ordinance from both technical and legal standpoints. In general, the City pledged to provide the same type service that had been promised by the private haulers. The customers would be charged for the mandatory service using a modified system of user charges. The basic charge was set at $1.50 per month per standard container of less than 32-gallon capacity with a $3.00 minimum per month. Twice-per-week, backyard service was provided. Drivers report residences using more than two cans. Yard waste can be placed at the curbside but must be in plastic bags. Any plastic bag can be used now, but the City plans to become the supplier soon. The charge for the bags will include the cost of both collection and disposal.

Commercial establishments receive comparable service, but the minimum charge for two containers is $5.00 per month with each additional container costing $2.50 per month. Bulk containers compatible with front loading compaction vehicles are available at no charge from the City. Virtually any combination of volume and frequency can be purchased. A minimum of $11 is charged for a 1-cubic-yard bulk container collected once per week. Most residential and commercial customers are charged for service on their water bill. Customers not having water service are billed directly by the Sanitation Department.

The bulk of OSWMP's effort was in residential route design. The City provided a map showing the number of residential and small commercial stops on each block face of the City. Using the total number of stops for the City and an estimate of a fair day's work, it was possible to determine the number of trucks required to provide collection service.

The City, by establishing general policy for the service, provides the framework for the fair day's work calculations. The most important points of general policy needed are: length

of work day, type of service to be provided, and frequency of collection. Several possibilities were considered, using a four-day work week based on a 10-hour day. The first plan used one crew and would have been operated with either Wednesday or Friday as the off day. Another plan involved using two crews working four 10-hour days on a rotating schedule within a work week consisting of six 10-hour days. The final choice was to have one crew work a six-day week, 8 hours per day, with the overtime to be included in the contract costs.

The City had been using standard metal and plastic containers with backyard service for some time. OSWMP recommended changing to curbside service, and the City was in favor of the suggestion because of the potential savings—as much as 30 percent. But the change from private to public collection was receiving a great deal of attention and any further changes might have resulted in opposition. The savings are so impressive that the City is now seriously considering using curbside service rather than a rate increase when their costs increase.

Commercial route design was based on a survey of the City's commercial establishments. Each establishment was contacted by the City. The interviews established the volume of waste generated and the frequency of collection desired. The survey showed that over 700 collections per week from bulk containers would be required to service the commercial community.

When the study began the decision was supposedly firm that rear loading compaction vehicles would be purchased. The City began to consider front loading vehicles after the commercial survey was completed. OSWMP recommended the rear loaders because such vehicles had already been purchased for the residential routes and the acquisition of more specialized equipment would complicate the problem of providing back-up vehicles. Also, the City Council had authorized the purchase of only 12 vehicles, of which nine, ordered for residential services, did not have the capability of collecting bulk containers. OSWMP personnel felt that the overall reliability of the system would be in jeopardy if front loaders were ordered before sufficient back-up equipment for residential collection could be obtained. Rear loaders could provide both commercial and residential service.

Unpublished OSWMP data on the performance of both rear loaders collecting bulk containers and front loaders collecting bulk containers was used to calculate that three trucks would be required to service the commercial establishments. City officials, however, decided that only two trucks would be sufficient. Their estimates were apparently based on information provided in manufacturer's brochures. Since the collection system was initiated in February 1973, the City has decided to purchase an additional front loading vehicle.

This project did not make any contribution to developing the disposal system. The 100-ton-per-day incinerator system the City had decided upon met with stiff public opposition of the type experienced in many communities. A citizens group near the proposed site used a lawsuit to delay construction of the incinerator for about six months. The facility became operational in the late summer of 1973.

## RESULTS

The collection system has been operational since February 1973. The best result so far has been the elimination of 55-gallon drums as residential storage containers. But there have been many mechanical problems with the collection vehicles. Absolutely no back-up equipment was provided so there has been a considerable amount of overtime worked, a situation which has further aggravated the breakdown problem. Since the residential routes are collected using a "flat fee" contract, the overtime is not paid to the contractor. There may be some problems in negotiating new contracts when the present ones expire unless the additional work load due to lack of proper back-up equipment is somehow reduced.

The City had three contractors for the residential routes at the outset of the new system, with each contractor assigned three of nine collection routes. After about two months, two of the three contractors were fired, and all three routes were assigned to one contractor. The City is collecting the bulk container routes with its own drivers.

A benefit derived from the project was the increased ability of the Sanitation Director to use the latest management techniques in his daily activities. He now has a working knowledge of route-design tools and has applied them well. Due to the equipment problems he has encountered during the early stages of implementation, he was able to initiate some radical changes in the original system with minimal disruption in service to the citizens.

## FINANCIAL BENEFITS

The overall cost to the residents of Hot Springs is approximately the same for the public system as for the original private system. However, each resident now receives reliable collection service twice each week.

The commercial accounts pay considerably more for service now, but the exact difference in cost will probably never be known since records were not kept before the City assumed collection responsibility. The commercial establishments also receive much more reliable service from the new system, which helps to offset the higher costs.

## LITTLE ROCK, ARKANSAS[1]

Before March of 1972, Little Rock, Arkansas, had a functioning twice-weekly solid waste collection system. However, there was room for improvement in the overall efficiency of the operation, especially in the area of effective route balancing and in the handling of waste from commercial establishments. The City of Little Rock felt that any savings which could be incurred in the collection operation could be applied toward an environmentally acceptable disposal method. Major Technical Assistance was initiated in March 1972.

Prior to MTA, Little Rock, with a population of 132,000, was divided into 27 residential collection routes. Most of these were composed of two sections, one being collected Mondays and Thursdays, the other Tuesdays and Fridays. Both sections were collected Wednesdays for dry trash and yard wastes only. Twenty-cubic-yard rear loading packer vehicles were used for this residential service. Most commercial accounts were collected by Arkansas Waste Disposal, a private contractor. However, the City serviced more than 200 2- and 4-cubic-yard bins located at schools, churches, small shopping centers and small commercial establishments.

The crews on the routes consisted, for the most part, of five men each. They were composed of one driver, two set-out men, one collector, and one set-back man. The driver usually stayed with the truck, not collecting unless his crew encountered a service having an unusually large number of bags or containers. Quite often the set-back man assisted the collector, leaving the cans to be set back by the homeowner. As an incentive system, the City allowed the collectors to leave work as soon as their routes were completed, a system within which the collectors generally worked about 30 hours per week even though they were paid for a 40-hour week.

In early 1972 the City began planning for the opening of a new disposal site which was located further from the City than the existing dump. Little Rock and OSWMP personnel joined forces in an effort to minimize the effect of the longer haul times upon existing operations and to plan for future productivity increases.

### HOW OPERATIONAL COSTS WERE CUT

A time study of the existing system was conducted to determine where efficiencies might be made in the system. This study revealed a number of problems in the collection system. Many homes on the sample routes examined were not receiving set-back service, as the set-back man on the crew was instead working as a collector; residents accepted this situation, as evidenced by the small number of complaints received by the City Administration. In addition, many residents seemed unaware that yard waste should be set out on Wednesdays since it was often set out with household waste. The collectors, as a result,

[1] Appendix A lists the names and addresses of local and Federal personnel involved in this project.

would have to examine each can to determine if it contained the type of waste to be collected on that day.

Another problem was in commercial collection. Commercial accounts were often mixed with the residential collection routes. Many of these commercial accounts used ungainly 55-gallon drums for waste storage, slowing the collection of these routes. As a result, the distribution of charges did not reflect the true cost of commercial collection. Residential collection was, in fact, subsidizing commercial collection.

After analysis of the time study data, it was decided that more detailed information was needed on how each crew spent its time. This was done through application of the COLMIS collection management computer program to the residential routes. During the first day of the 3-week data collection period, the drivers were interviewed after they completed their routes to make certain they were filling out their information forms correctly. This was particularly important in assuring data validity.

Analysis of the COLMIS data revealed that commercial collection, while requiring almost a quarter of the collectors' time, generated only about one-tenth of the Sanitation Department's revenue, with the difference being made up by the attaching of a $2.50 monthly charge to the water bill of each dwelling unit.

The results of the COLMIS program were then used to model the City. The City was broken into small homogeneous areas, within each of which a determination was made of the Sanitation Department manpower and equipment requirements. Using this model as a data base, and time studies from other collection systems, it was possible to study the effect of modifying certain elements of the collection system. Equipment requirements were then determined using various types of collection trucks. The model analyzed the system with the existing rear loading packer trucks, and with side loading vehicles with right-hand drive and smaller crew sizes. For each type of truck used, a cost analysis was performed for the collection system with set-out/set-back service, set-out service, and collection at curbside. Since the City was considering a 10-hour day, various alternatives using this possibility were analyzed. Ten alternatives were presented to the Little Rock Board in October 1972. In addition, combined garbage and yard-waste collection, the elimination of all commercial collection which could not be handled in the same way as residential collection, and the elimination of the use of 55-gallon drums were recommended. Finally, a feasibility study was performed on the economics of constructing a transfer station; it turned out to be economically unjustifiable.

## RESULTS

The City dropped 200 commercial accounts, the total number falling from 1300 to 1100. Most apartments, schools, and gas stations, those accounts most difficult to collect, were dropped. The remaining accounts were principally "mom and pop" establishments which could be handled as if they were residential. The use of 55-gallon drums was banned, with a beneficial effect on

the remaining commercial accounts. The remaining commercial accounts are now using acceptable containers. These adjustments permitted one of the two completely commercial routes to be eliminated.

The City placed orders for five new right-hand drive, side loading trucks and five new rear loading trucks. After delivery, the vehicles were operated by two men each, with the goal of phasing the trucks into one-man operations. If this proves successful, more trucks will be ordered.

Residential set-back service was eliminated because most of the residents had not received this level of service anyway. This resulted in a crew size reduction from five to four men. No layoffs were required since attrition and other job assignments accounted for the manpower reduction.

The City still practices separate collection of yard waste on Wednesdays, though many crews make combined collection on their own initiative. The City has made no formal decision on this aspect of the project, but believes the status quo is adequate for acceptable collection.

The collection personnel have also benefited from the project. By relying on the collectors for information, whether in filling out COLMIS data sheets or in reporting 55-gallon drums and time consuming commercial accounts, the collectors have been brought into greater participation in management decisions. More importantly, as a result of discussions surrounding absenteeism and labor turnover, the City has instituted a training program on Wednesday afternoons. This program teaches basic reading and writing skills to participating Sanitation Department employees.

## FINANCIAL BENEFITS

With the elimination of set-back service, the cost of approximately one man per crew was eliminated. Although some residents now receive a lower level of service, the cost of the previous service far exceeded the benefits gleened by the City. The savings accruing from eliminating 27 crewmen at $6500 per year each is $175,000 per year. The elimination of one commercial collection truck resulted in a savings of $20,550 per year, which had covered the annual cost of one truck and salary for a laborer and a driver.

These savings of $196,000 annually are being applied to offset the increased haul costs and operating costs at the City's new disposal site. Thus, the project has been successful in applying collection savings to the improvement of the disposal operation.

## PORTLAND, MAINE[1]

Major Technical Assistance was initiated in Portland, Maine, in February 1972. Prior to that time, this City of 65,000 persons had provided residential curbside collection of trash every other week and had contracted with a pig farmer for weekly collection of residential food waste. Funds to support this costly duplication of effort—$227,000 for the City and $89,000 for the farmer—were appropriated from tax revenues. Commercial and industrial establishments were required to contract directly with private haulers.

Operational inefficiencies further added to the City's costly collection system. As the community grew, new collection stops were haphazardly added to existing routes. This practice resulted in an unequal distribution of workloads among the collection crews and days of the week; overtime was required on some days while on others the collectors finished early.

Since much of this new growth occurred in areas distant from the disposal site, the City added an additional crew truck for collecting in those areas. This meant that during the first week of the two-week cycle five trucks, each with a three-man crew, were used, and during the second week, when the outlying areas were collected, six trucks, also having crews of three men, were used. Each day one of the trucks was used half time on litter barrel and municipal building collection.

The City's policy of a fixed lunch from noon to 12:30 pm at the garage forced the crews to spend potential collection time driving to and from the garage. A flexible lunch period would have permitted the crews to stop for lunch while traveling to or from the disposal site.

Inefficient vehicle routing also added to costs. Routing of the vehicles through the collection areas was left to the drivers' imaginations, and several routes were not geographically contiguous, which forced the crews to spend more time driving than was necessary. Many streets were traversed several times by crews doubling back to pick up street segments.

In addition to many collection inefficiencies, varying regulations established by different public works directors over a period of time created a situation in which some apartment complexes received municipal service while others were forced to contract directly with private haulers. Approximately 80 percent of the apartment buildings containing eight or less units received municipal collection while only 50 percent of the larger buildings received it.

Finally, the City has been operating an open dump. Cover material, when used, is improperly placed. A fire hose continually spraying water into the fill does little to prevent fires and adds greatly to water pollution around the site.

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[1] Appendix A lists the names and addresses of local and Federal personnel involved in this project.

## HOW COLLECTION EFFICIENCY WAS IMPROVED

During 1971, the Public Works Director recognized that the City needed improvement in its collection and disposal operations. The City and the Greater Portland Council of Governments began planning to convert the City dump into a sanitary landfill. However, Portland, like many other American cities, was facing financial problems and was reluctant to implement the weekly collection service requested by many citizens *and* convert its inexpensive dump into a sanitary landfill.

It was at this point that the Portland Public Works Department and OSWMP agreed to a joint effort with increased collection-crew productivity as the key goal. The disposal problem was not specifically addressed by the OSWMP/City team; rather, it was left to the Greater Portland Council of Governments which appeared to be progressing well toward its goal of locating and operating a regional sanitary landfill.

The team's first task was to collect data on the existing collection system in order that the COLMIS computer program which was at that time still in the developmental stage could be used. COLMIS provided definitive information on the operational aspects of collection and the costs involved and provided information on generation rates, collection time per stop, overtime costs, time spent driving to the disposal point and on other functions which require regular management attention.

Maps showing one-way streets, major arterials, population density, existing routes and collection services by block were prepared by City personnel. The initial accuracy of the collection services map is critical since this information is used to balance workloads among crews. A quality control check, however, showed numerous errors in the map and therefore the route balancing effort required much more time than usual.

During this data gathering phase, the City Manager, because of a problem in breaking the existing contract with the pig farmer, decided that the City should continue to collect residential waste only. He therefore decided not to propose implementation of the combined collection of trash and garbage until September 1973 when the farmer's contract expired. This meant that the community would face a temporary increase in collection costs upon implementation of weekly trash collection. City Council approval of this increased cost and the purchase of new equipment was necessary. The Public Works Director estimated that a maximum of eight collection routes, an increase of three routes, would be required at an additional cost of $80,000 annually. In addition, $38,000 would be needed for the purchase of two additional 20-cubic-yard rear loading packer vehicles. (The existing budget had authorized the purchase of one new vehicle to replace an older 16-cubic-yard truck.)

After discussing the proposal and considering the extra cost, the City Council decided to postpone weekly collection until the September 1973 termination of the garbage contract. Their decision, however, was strongly opposed by a local community action group in the

Model Cities area of the City. The Council reconsidered its decision at its next meeting and voted to implement weekly collection and approved the purchase of the two additional 20-cubic-yard rear loading packer trucks.

Once given the authority to implement weekly collection, the City was faced with several additional policy decisions regarding crew size, collection from apartments and on-site storage. Therefore, the joint team began an intensive study of collection from multiple family dwellings. The cost for serving various size apartment buildings using both conventional and bulk containers was calculated. From these figures it was recommended that whenever possible, apartments containing nine units or more should have bulk containers. Unfortunately, the majority of apartments in Portland could not locate the bulk containers where they would be easily accessible. The study also showed that the City collected from more than 80 percent of the apartment buildings with less than nine units, from approximately 60 percent of those containing between nine and 19 units, and less than 30 percent of those containing more than 19 units. In addition, tax records showed apartments paid a smaller percentage of the City's cost to collect their waste than did the single family homeowner. This information along with four alternative policy recommendations concerning collection from multiple family housing units was submitted to the City Council. The Council chose the most expensive alternative, the one whereby waste would be collected from *all* residential units and apartments even though the additional annual cost was projected to be $95,000. This alternative was selected because the Council did not want to force the lower income housing units to pay a user charge in addition to taxes for a service which many had been receiving for taxes only. It also believed that municipal collection for no user charge would help in the community's fight against litter in the low income areas. The City probably will not provide collection service to *all* apartment complexes because it is offering only once per week collection and can only collect those bulk containers that are suitable for rear loading vehicles. Therefore, some complexes will continue using private contractors that offer a higher level of service.

Once the apartment policy decision was finalized, the OSWMP/City team began planning for implementation. In order to determine the number of routes required, the team decided to base its calculations on an 8½-hour work day (excluding lunch) for the peak waste-load period. This meant that the collection crews would finish early during average and low generation periods but would work overtime during the six peak weeks of the year.

Since basic information collected by the COLMIS program was gathered during a low generation period, it was corrected to the peak period using disposal site weight records. Next, the biweekly weights had to be corrected to weekly weights. Studies have shown that as frequency of collection increases the weight collected tends to increase. The team decided to use a 20 percent correction factor. The average weight at the curb during weekly collection was assumed to be 60 percent of the biweekly weight—an assumption which turned out to be very accurate.

Using the corrected basic data, the street maps and the City Council's policy decisions, the team divided the City into five equal workload districts. Calculations then showed that

seven trucks rather than the eight originally estimated were required. (One truck with a three-man crew working half time on litter barrels and collection from municipal buildings was necessary.) Finally each vehicle was optimally routed through its collection district using the heuristic routing technique.

At the end of October 1972, after numerous equipment delivery delays, the City implemented weekly collection. Each truck driver was given a route map and a verbal description detailing the exact vehicle routing. In addition, extra management personnel worked with the foremen in assisting the drivers through the routes. Minor changes in vehicle routes were made as conditions dictated. However, the drivers were encouraged to follow their routes as closely as possible.

While rapid progress was made on the improvement of the collection system, the date for implementation of the regional sanitary landfill was still remote. The plan to convert the City's dump into a regional sanitary landfill was scrapped because the expected life, available cover material and environmental impact were not favorable.

The Council of Governments has granted approval, and is now seeking approval from individual communities, of a $2.5 million refuse disposal plan including a baling station and landfill. A site had been selected, and the summer of 1974 was set as the target date for operation.

## RESULTS

The City's decision to provide service to all apartments increased the total number of dwellings eligible for weekly municipal trash collection by 10 percent. However, because the City has not wanted to take food waste to the existing dump, the citizens have not begun receiving combined collection of garbage and trash. In the interim, the pig farmer's contract has been extended. When weekly combined collection is commenced, seven vehicles will be needed, an increase of only two vehicles and six men over the present operation. The savings the City expects will be used to offset part of the increased costs of acceptable disposal.

## FINANCIAL BENEFITS

The new weekly combined collection system will save the taxpayers approximately $30,000 annually. However, this does not take into account the additional cost of the expected regional sanitary landfill. It currently costs the City $1.05 per ton to operate its dump. If the regional site costs $3.00 per ton, the additional cost of disposal—based on the expected volume—will be nearly $53,000 annually. Thus the savings will be used to offset about 60 percent of the additional cost of the environmentally acceptable disposal system.

## SOUTHEASTERN OAKLAND COUNTY, MICHIGAN[1]

In 1951, the administrators of 14 communities located in Southeastern Oakland County, just north of the Detroit city limits, joined together to form the Southeastern Oakland County Incinerator Authority (SOCIA). SOCIA's job has been to provide disposal facilities for the area's 350,000 residents.

For two decades, the member communities were very satisfied with the disposal services SOCIA provided. In 1971, the member communities approached the SOCIA General Manager with a request that SOCIA study the solid waste collection practices in use and assume an advisory role in upgrading the collection services.

The SOCIA staff felt that a potential cost savings was possible, if the efficiency of the collection operations could be improved. However, a great deal of hard data would have to be gathered before any real progress could be made. SOCIA also wanted to do something about the general lack of back-up equipment available to member communities when their regular equipment was out of service. Four communities had no back-up equipment at all, which resulted in a great deal of crew overtime and collection schedule readjustment whenever there was a breakdown.

Commercial waste collection practices varied widely among communities with respect to level of service and charges. Some communities offered no commercial collection services even though property tax revenues being paid were supposed to cover collection costs. Other communities provided services, but without a system of charges based on the quantities of waste collected.

Five of the 14 communities were under contract to private collection companies under franchise agreements, and three communities were considering franchising arrangements. Many member communities were anxious for SOCIA to offer collection services in order to compete against the private sector.

In March 1971, the SOCIA General Manager requested Major Technical Assistance from the Office of Solid Waste Management Programs. The SOCIA staff felt the need for guidance in studying the above problems and the feasibility of a regional SOCIA-managed and -operated waste collection system.

### HOW COLLECTION SERVICES WERE IMPROVED

From March through November 1971, SOCIA gathered information on the solid waste collection systems of each of the 14 member communities. The data provided insight into

[1] Appendix A lists the names and addresses of local and Federal personnel involved in this project.

the collection operations of the communities and served to redirect the effort towards a program of individual technical assistance to member communities seeking assistance.

COLMIS was used to provide basic data on the detailed operations of the collection systems within SOCIA. Seminars were conducted to brief the various City Managers, Mayors and Department of Public Works Directors in its operation.

Collection crew drivers submitted COLMIS-required daily activity reports to their foremen who in turn forwarded the reports to the SOCIA staff on a weekly basis. OSWMP provided data-processing services and supplied the COLMIS output reports to the SOCIA staff who then distributed weekly community reports to all Public Works Directors.

A series of bar graphs comparing several parameters of the waste collection systems operating within SOCIA were prepared. The most important parameters were considered to be:

1. Average number of homes served per crewman per collection hour—The COLMIS results showed this to vary from a low of 28 homes per hour for one community to over 90 for another; the average for all 14 communities was 40 homes per hour.
2. Average weight collected per crewman per collection hour—This ranged from 0.5 to 2.5 tons per hour for the various communities, with the average for all communities being 1.3 tons per hour.
3. Average cost per home per collection—The lowest cost was 17 cents in one community, and the high was 41 cents; average cost for all communities was 30 cents.
4. Analysis of collection performance as a function of crew size—Cost per home worked out to 10 cents for one-man crews, 14 cents for two-man crews, and 17 cents for three-man crews.

The bar graph comparisons of the communities gave a great deal of insight into differences in operation and showed where improvements could most easily be made.

As for the question of need for back-up equipment, SOCIA and OSWMP studied the frequency of breakdowns as reflected in the COLMIS reports. For the four cities that had no back-up equipment, the total number of days out of a three-month period that back-up equipment could have been used was 24. This corresponded to 96 days per year. Holidays, and the need for overtime efforts on Saturdays to make up for them, would produce an additional demand for back-up equipment of 30 days per year.

A one-man collection unit costing $27,000 and amortized over 5 years (allowing 10 percent salvage) costs $4,860 per year; adding to this the costs of insurance, maintenance and contingency repairs brings the total yearly cost to $6,000 for SOCIA to provide a back-up vehicle. Assuming that this vehicle would be used at least 100 days out of the 260 regular working days, a rental fee of $60.00 per day would cover the costs. This is a reasonable charge when alternative costs are considered; for example, a breakdown causing collection

to fall behind so that Saturday work would be required would involve a $13.00 per hour labor cost, or $104.00 per day, plus fringe benefits.

Commercial collection practices were surveyed by SOCIA and it was found that inconsistencies existed between cities with respect to frequency of collection and service charges. Interviews with each of the City Managers indicated it would be difficult to establish a uniform SOCIA-wide rate structure for commercial collection.

SOCIA has been considering direct involvement in the operation of specialized collection equipment for large commercial establishments and apartment complexes. This effort has not yet been completed due to the extensive field work required to gather the necessary data. It appears thus far that each SOCIA member community had difficult or costly commercial stops which could be serviced by a system of specialized equipment that would service the entire SOCIA area. To this end, each city is compiling a record of its commercial accounts, their frequencies of collection, amounts, names and addresses.

Once the larger accounts are isolated from the commercial routes of each city, the re-routing of the commercial collection vehicles should produce greater efficiencies in the commercial collection. The possibility of merging small commercial neighborhood pockets into the residential routes, as is currently done in the smaller cities, will also be studied.

It is anticipated that SOCIA would acquire the specialized equipment necessary to service large commercial accounts and would operate as a special collection agency, thereby relieving its member communities of this responsibility.

In evaluating the feasibility of a SOCIA-operated regional collection system, it was determined that the system with the lowest cost per home would use one-man collection crews with side loading vehicles. The SOCIA staff indicated that the one-man collection system would be the mode of operation should SOCIA actually become directly involved in solid waste collection.

## RESULTS

SOCIA has been operating the COLMIS program since June 1972. The Authority is convinced that the COLMIS reports have provided a valid measure of performance and a basis of comparison for evaluating its member cities' waste collection operations. In January 1973, SOCIA contracted with a local data firm to produce the COLMIS reports as a service to the member communities.

The introduction of one-man collection vehicles has proven successful. The vehicles have been well received by employees, especially in working on high-traffic-volume streets. SOCIA has surveyed each member community to determine the status of back-up equipment available

for solid waste collection and the need for a SOCIA operated back-up equipment pool. In December 1972, the SOCIA Board of Directors acted on the proposal of providing back-up collection equipment at a rate of $60.00 per day per truck. The pool should be in operation by the summer of 1974.

The study of commercial waste collection operations has not convinced the member communities that SOCIA should be directly involved in commercial collection. In most instances, the prevailing attitude has been that "commercial collection doesn't present the problems we have with residential collection and commercial accounts are paying their fair share." The SOCIA study showed this to be in error, but strong political pressures have tended to resist any changes in commercial collection policies.

The idea of a regional collection study has not received a high priority by the SOCIA staff, and consequently, even with OSWMP encouragement, the study has not progressed very far. It is generally felt that the duty of SOCIA at this time should be to assist in the continuing improvement of the present system. When the cities have developed their operations to maximum efficiency, SOCIA will be in a position to analyze the differences in unit costs between the cities and make effective recommendations in combining routes, especially in the smaller cities, to gain further economies in the overall system.

## FINANCIAL BENEFITS

A measure of the success of the effort in collection efficiency improvement is reflected in the gradual decrease in the collection cost per home per week. Costs have decreased from an average of 31¢ in June 1972 to 26¢ in January 1973. For the 85,000 homes serviced, this corresponds to an annual savings of $221,000. This decrease is a direct result of crew-size reductions and more efficient routing. Further reduction of costs is expected.

## LATAH COUNTY, IDAHO[1]

Latah County is one of the northernmost counties of Idaho. It has nine incorporated communities, the largest of which, Moscow, has a population of 14,000 persons. The eight other communities have a combined population of 3800 while the remainder of the County's 7000 residents live in rural areas.

Prior to October 1972, mandatory collection was practiced in the City of Moscow; throughout the rest of the County, collection was sporadic at best, with only two of the other eight incorporated communities having mandatory collection. The remaining communities had some service available, but it was on a voluntary basis and was usually by part-time collectors using open trucks. Backyard burning was common, adding to air pollution. Rural collection was even more of a problem since not even voluntary collection was available.

The disposal situation was also unacceptable. The largest site was operated for the City of Moscow. Attempts to maintain it as a sanitary landfill failed due to a lack of daily cover at certain times, particularly during rain. The soil there, as in other parts of the County, is a clay of low permeability which becomes difficult to handle when wet. The other incorporated cities also operated disposal sites, but they were all open-burning dumps having little planning or control. Air pollution from the burning, and surface and groundwater pollution from these dumps had been a continuing problem. In addition, all sites had insects, one had rodents, and two others showed signs of feeding by bears and other large animals. The fires were also a hazard to people in the vicinity and to the adjacent forests. In rural areas, residents resorted to illegal roadside dumps throughout the County.

Even though County Officials had had no prior experience in solid waste management, they decided to proceed with a complete County system in accordance with a State law making it the duty of counties to provide solid waste programs. A special Solid Waste Study Committee was appointed along with a consultant to plan the project. The County decided that the project would be a contract operation and would involve complete County-wide collection with the contractor bidding on from one to three sanitary landfills at his option. The sites themselves plus plans and specifications were provided by the County. A contract was awarded in August of 1972. The contractor chose to operate a single landfill to be located near the population centroid of the County, an area also having easy accessibility from all directions.

At this point the County requested technical assistance from EPA's Office of Solid Waste Management Programs. OSWMP, it was hoped, would review the County's plans and find any points the County might have overlooked; and further, it might make suggestions to keep past problems from recurring. Also, there were the public relations problems of implementing any new systems; and as for the open dumps, the County still had no plan or knowledge of the methods and equipment necessary for their effective closing. There was

[1] Appendix A lists the names and addresses of local and Federal personnel involved in this project.

also the need for specific recommendations for the continuing management of the system. The County was on the verge of providing the best solid waste service in the State, but Officials realized that there was still much work ahead to insure that it would operate most efficiently.

## HOW THE COUNTY ALTERED ITS PLANS

Of immediate importance was the preparation of the sanitary landfill site; the collection contract had been signed in August 1972 and the landfill had to be in operation by the beginning of October. OSWMP reviewed the County's landfill plans and specifications and found a number of points in need of improvement.

The landfill is in a 20-acre basin. Calculations based on expected waste load, compaction, and soil-to-refuse ratio showed that with the original design the landfill would last only about three to four years, even though it had been leased by the County for 10 years. In addition, the planned trench excavations turned out to be below the water table, an unacceptable situation. The site was redesigned and, as a result, is now expected to last for more than 12 years.

Many other points in the proposed landfill operation needed attention, everything from a holiday policy for the workers to providing for winter and wet weather operation. The high clay content of the soil makes wet weather particularly unwelcome since the soil holds water, does not drain well, and becomes difficult to move properly. A system of drainage ditches and trenches and a method of grading the work areas have worked effectively in keeping the landfill open in all weather.

A field examination of actual operations showed that there was more than adequate time for all required activities of traffic directing, refuse spreading, compaction, covering, and excavating, but the otherwise smooth operation was hampered by the narrow 20-foot-wide working face. For persons unloading their cars, not more than two cars at a time could gain access, thus causing delays. Also the dozer did not have enough area to compact while unloading was in progress. Widening the work face to 40 feet helped.

Another problem was that top soil was being mixed with other soil. Since the site was eventually to be returned to its original agricultural use, the top soil had to be more thoroughly separated. Excavations were not being properly carried out and in some places the fill's lifts were not coming up to specification. The use of surveying markers made it easier for the dozer operators to check alignments and elevations as needed.

A groundwater analysis program was established to periodically monitor water quality. Another operational check will be the scales when they are installed.

All of the above recommendations were made to the County in writing and through discussions with the County Coordinator and the contractor. Operational points were also discussed with the dozer operator at the site. Most of the changes cost nothing, but they made for improved use of the site. The only extra costs were for test holes and gravel. The same manpower and equipment were used, but in a more effective manner.

The collection operation in the new areas to be served–that is, outside Moscow–expanded first to the incorporated cities. Two 16-cubic-yard packer trucks were purchased for the task. These would also eventually serve rural areas.

At this stage the effort was to balance the routes and provide equal workloads. Data forms with directions were prepared by the OSWMP Project Engineer. The County, however, could not spare the manpower to gather the data, so it contacted the University of Idaho where there was a program of financial aid for students working in community assistance. As a result, a senior civil engineering student undertook to gather, analyze and report on the data gathering. One of the points he studied was the use by commercial establishments of 1- to 2-cubic-yard containers designed for mechanical loading into rear loading trucks. This was important since the use of containers was part of one of the alternatives for collecting from rural residents.

The alternatives for rural collection were:

1. *Container collection, with containers being an average of 1.6 miles from residences*–Cost: $1.88 per month per customer. Two-man crews would be necessary for safe handling of the containers.
2. *Weekly collection with service at the road*–Cost: $2.92 for one-man crews, $3.40 for two-man crews.
3. *Biweekly collection with service at the house*–Cost: $2.42 for one-man crews, $2.90 for two-man crews.

The first alternative was decided against because there was no way to assure that people using the containers would be paying for the service. The second alternative was deemed unsafe for motorists driving through the winding roads and unexpectedly finding a parked packer truck. The third alternative promised a reasonable level of service at a moderate cost.

Implementation of rural collection was difficult because of the scattered population. The County was broken up into manageable areas, then a detailed public information program was carried out. The new system was described at public meetings where residents could sign up for service at that time and their locations could be marked on an area map. The advantage of the map was that mailing addresses are usually inadequate in telling exactly where rural homes are located. Visits were paid to those persons not receiving service to explain that because service was now available open burning was no longer legal and County ordinance required all waste to go to the landfill.

With the opening of the landfill and the provisions for collection service, each community was in need of a plan for closing its dump. The site serving Moscow was closed by a contractor.

The OSWMP Project Engineer visited the other sites, and from the information obtained, a plan for each site was developed. Each plan consisted of a locational map plus a site map showing all pertinent features. An accompanying narrative explained where the refuse could be moved, if need be, how and where to compact it, sizes and types of equipment needed, where cover material could be obtained, and how to grade and seed the final covered surface. Costs had to be absorbed by the communities involved, but the result was the removal of numerous eyesores.

The County also requested OSWMP to consider the future management needs and to make suggestions for the control of the fully operational system. Guidance was provided in the areas of data collection and analysis, records maintenance, contractor relations, public relations, enforcement, and training. The recommendations were accepted by the County and a Solid Waste Coordinator to head the County system was named.

## RESULTS

All cities in the county have now joined the system. The environmental benefits of the project are many. The fact that collection is available will reduce instances of poor refuse storage conditions at residences and commercial establishments. Air pollution will also be cut by the elimination of burning in dumps and backyards. The use of the sanitary landfill will prevent the water pollution that had taken place with the open dumps. Insect and rat problems will also be controlled.

## FINANCIAL CONSIDERATIONS

The cost of the weekly service to city residents and biweekly service to rural residents has worked out to $2.90 per month. Cities keep 10 percent of the fee before paying the County; the County keeps 10 percent to pay for the site, enforcement and management; the remainder goes to the contractor. For this cost, the citizens of Latah County get cleaner air, cleaner water and a more appealing countryside.

## COLORADO PLANNING REGION NO. 10

## MONTROSE, COLORADO[1]

The Colorado Planning and Management Region 10 consists of six very rural and mountainous counties in the southwestern part of the State. The counties are Delta, Gunnison, Hinsdale, Montrose, Ouray and San Miguel with a total population of 45,000. The area is characterized by small towns, scattered homes and farms, lack of adequate transportation facilities and low median income. Because of these conditions, services were limited and routes were disorganized or lacking altogether. Disposal sites were small, scattered, open-burning dumps. Of the 29 State-designated disposal sites in the six-county region, only two were in compliance with State regulations. An uncounted number of illegal roadside dumps plagued the area. Since the population of the counties was small and incomes were low, there was not enough money to support an efficient collection and disposal system. Thus the problem was to correct the existing situation of unauthorized and inadequate disposal and irregular and inefficient collection at a cost the areas could support.

The problem had been aggravated, however, by an Executive Order which made it imperative that several Federal agencies, particularly the Bureau of Land Management, move quickly to either close or upgrade existing dumps that were operating on Federal land. Also the Russel Stover Candy Company had indicated plans to construct a 600-employee plant in Montrose, dependent upon the community's pledge to provide waste collection and disposal. This expected increase in the normal waste load demanded a revision in Montrose's collection and disposal operations.

### A WORKSHOP IS HELD

In August 1972, the Executive Committee of the District 10 Regional Planning Commission held a regular meeting and discussed the need for solid waste planning. The Committee, at the urging of the Montrose City Manager, voted to recommend a detailed study of the Region's actual solid waste accumulations and authorized the Big Country Comprehensive Health Planning Council to submit a project grant application to EPA.

Based on the documented need for solid waste planning, the Health Council submitted a pre-application proposal to EPA's Region VIII Solid Waste Management Office for funds to develop a multicounty solid waste management system for the collection, processing and disposal of solid waste in an environmentally acceptable manner.

The pre-application was approved in November. However, between the time the pre-

[1] Appendix A lists the names and addresses of local and Federal personnel involved in this project.

application was approved and the formal application was to be submitted, EPA changed its administrative policy regarding solid waste planning grants.

In response to a suggestion by the Office of Solid Waste Management Programs, a decision was made locally not to submit the formal application, but instead to hold a workshop for local officials to outline potential solutions and the approximate costs of each. OSWMP was then asked to provide technical assistance.

OSWMP responded by sending two specialists in rural systems—an urban planner and an engineer—to the workshop set up by the Planning Commission and the Health Council. The workshop was attended by various county personnel and by representatives from the National Park Service, the Forest Service, the Bureau of Land Management, and the Colorado Department of Health.

On the first day of the workshop, a group meeting was held to discuss the project area and a general overview of rural collection and disposal systems. A smaller meeting was then held to discuss the goals of the workshop and to define refuse sheds within the project area.

On the second day a group meeting was held to discuss the efforts of two neighboring counties in solving their solid waste management problems. A Bureau of Land Management representative discussed his Agency's policy with regard to the buying and leasing of land for solid waste disposal. A number of smaller meetings were held the rest of the day on the following topics: general financing and funding requirements, City of Montrose solid waste volume increases, and costs of regional vs. separate-county systems.

The third day of workshop meetings considered specific county problems and possible solutions. Two County Commissioners from San Miguel County came to discuss their County's solid waste problems. Two private haulers also came to offer their suggestions.

A final meeting was held on the fourth day to organize the general findings of the workshop and the possible solutions on regional and county-by-county bases.

## RESULTS

It had been the hope of the Director of the Health Council, in requesting OSWMP technical assistance, that EPA would do two things: provide representatives to focus and direct the workshop and meetings; and develop specific alternative systems for the counties and advise local officials of costs and specific equipment requirements for each alternative.

EPA, on the other hand, limited its contribution to the presentation of general approaches to rural waste collection and disposal. Costs and effectiveness of varied solutions were presented. In addition, EPA encouraged regional disposal sites rather than multiple sites within each county.

The decision to provide this type of assistance rather than developing and submitting a set of specific alternative systems, including costs and equipment requirements, was based on EPA's belief that plans developed through the expenditure of local funds and/or manpower are more likely to be implemented than those which are funded or developed by outside agencies.

As a result of the week-long workshop and the contributions from the U.S. Forest Service and the Bureau of Land Management, a report was prepared by the Director of the Health Council. The report presented sound alternatives to area officials and provided the basis for establishing economic estimates of various county systems and the steps needed for implementing those systems.

Presentation of alternate systems to Hinsdale County, coupled with pressure from the Bureau of Land Management, brought about the closure of a county-operated open dump and a decision by the largest municipality in the County, Lake City, to begin a sanitary landfill on the site of what had been an open dump. Hours of access to the landfill have been limited, an attendant is on site each day, and refuse is covered with six or more inches of earth at the end of each day. Gunnison County is operating a central sanitary landfill for the Gunnison River Basin at Gunnison. Much of the groundwork for this was provided by a 1972 Forest Service report.

Delta County has closed an open dump at Austin. Montrose (eastern section) and Ouray Counties have jointly decided on a rural green-box collection system to be funded from revenue sharing funds. The City of Montrose has had difficulty in deciding how to handle the waste from the Stover Company and has, therefore, been seriously behind schedule in its solid waste management improvements. Within the San Miguel Basin, the City of Telluride has passed a mandatory house-to-house collection ordinance and contracted with a private hauler for collection and disposal. The hauler also collects from County residents who live along the route to the disposal site. Four open dumps in the area have been closed and the site at the City of Norwood is now being operated in conformity with State standards. The Town of Redvale closed its dump and went to private contracting of collection and disposal.

Although EPA's assistance fell short of local expectations, it was felt locally that without it, in all probability, no meeting would have been held and no one would have been forced to become sufficiently knowledgeable in solid waste management to produce a local plan with implementable alternatives. In addition, the meeting served to bring varied State, Federal and local interests together. This resulted in an exchange of information and a provision for assistance vital to the interests of several communities within the Planning Region. Local officials now seem to have a grasp of the costs involved and a knowledge of the equipment needed to operate good collection and disposal systems.

## APPENDIX A

### Local and Federal Contacts

The following is a list of local and Federal officials involved in the various technical assistance projects described in this report. All Federal staff are from the Office of Solid Waste Management Programs, U.S. Environmental Protection Agency (1835 K St., N.W., Washington, D.C. 20460).

| *Local* | *Federal* |
|---|---|
| Akron, Ohio– | |
| David M. Zimmer, Director<br>Department of Public Services<br>203 Municipal Building<br>166 South High Street<br>Akron, Ohio 44308 | Kenneth Shuster |
| East Peoria, Illinois– | |
| Sherman Burrus<br>222 East Washington Street<br>East Peoria, Illinois 61611 | Bruce R. Weddle |
| Michael Edwards, Planner<br>Tri-County Regional Planning Commission<br>Peoria, Illinois | |
| Hot Springs, Arkansas– | |
| Vernon Turnbow, Sanitation Director<br>City Hall<br>Hot Springs, Arkansas 71901 | Allen Geswein |
| Little Rock, Arkansas– | |
| James Lynch, Administrative Assistant<br>City of Little Rock<br>Little Rock, Arkansas | Bruce R. Weddle |
| Portland, Maine– | |
| Worth Landers, Director<br>Public Works Department<br>Portland, Maine 14103 | Bruce R. Weddle |

| *Local* | *Federal* |
| --- | --- |
| Southeastern Oakland County (Michigan) Incinerator Authority– J. Lamerato, General Manager<br>SOCIA<br>P.O. Box 1248<br>Berkley, Michigan 48072 | George A. Garland |
| Latah County, Idaho–<br>James K. Armitage, Director<br>Civil Defense and Planning<br>Latah County Courthouse<br>Moscow, Idaho 83843 | Truett DeGeare |
| Planning Region No. 10 Montrose, Colorado–<br>Michael Vitek, Executive Director<br>Big Country Comprehensive Health Planning Council<br>Montrose, Colorado 81401 | Bruce R. Weddle |

## APPENDIX B

### Reading List of Current Reports on Solid Waste Collection

Single copies of the following reports can be obtained free of charge by writing to:
Solid Waste Information Materials Control Section
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268


Colonna, R. A., and C. McLaren, *comps*. Decision-makers guide in solid waste management. Environmental Protection Publication SW-127. Washington, U.S. Government Printing Office, 1974. 157 p.

Garland, G. A., and B. R. Weddle. Shaving solid waste collection costs. *Nation's Cities*, 12(2):13-14, 16-17, Feb. 1974. Reprinted, [Washington], U.S. Environmental Protection Agency, 1974. 4 p.

Shuster, K. A. A five-stage improvement process for solid waste collection systems. Washington, U.S. Government Printing Office, 1974. (In preparation.)

Shuster, K. A., and D. A. Schur. Heuristic routing for solid waste collection vehicles. Environmental Protection Publication SW-113. Washington, U.S. Government Printing Office, 1974. 45 p.

User's manual for COLMIS; a collection management information system for solid waste management. v.1. Environmental Protection Publication SW-57c. Washington, U.S. Environmental Protection Agency, 1974. 99 p.

User's manual for COLMIS; a collection management information system for solid waste management. v.2. Environmental Protection Publication SW-58c. Washington, U.S. Environmental Protection Agency, 1974. 49 p., app.


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